

# MONTHLY WEATHER REVIEW.

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The MONTHLY WEATHER REVIEW summarizes the current manuscript data received from about 3,500 land stations in the United States and about 1,250 ocean vessels; it also gives the general results of the study of daily weather maps based on telegrams or cablegrams from about 200 North American and 40 European, Asiatic, and oceanic stations.

The hearty interest shown by all observers and correspondents is gratefully recognized.

Acknowledgment is also made of the specific cooperation of the following chiefs of independent, local, or governmental services: R. F. Stupart, Esq., Director of the Meteorological Service of the Dominion of Canada; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. I. S. Kimball, General Superintendent of the United States Life-Saving Service; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Director Meteorological Office, London; Maxwell Hall, Esq., Govern-

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As far as practicable the time of the seventy-fifth meridian is used in the text of the MONTHLY WEATHER REVIEW.

Barometric pressures, both at land stations and on ocean vessels, whether station pressures or sea-level pressures, are reduced, or assumed to be reduced, to standard gravity, as well as corrected for all instrumental peculiarities, so that they express pressure in the standard international system of measures, namely, by the height of an equivalent column of mercury at 32° Fahrenheit, under the standard force, i. e., apparent gravity at sea level and latitude 45°.

## FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

During the last seven days of September a hurricane advanced from the Lesser Antilles of the West Indies to the Great Bahama Bank. During October 1 the vortex of the hurricane recurved northward over the western Bahamas. The following notes regarding this storm are from the Nassau, New Providence Island, Bahamas, Guardian of October 3, 1908:

The first intelligence that another hurricane had made its appearance reached us last Saturday (September 26), when we were informed by cable from Washington that a storm was central near and south of Porto Rico moving westnorthwest. This information was confirmed by telegrams from the same source dated the 28th, 29th, and 30th, stating that a hurricane was central near the eastern extremity of Cuba, and finally that a hurricane was central near the great Bahama Bank moving west-northwest. These statements were entirely borne out by the weather here on September 30, which throughout the day wore an exceedingly threatening aspect. \* \* \* By 8 a. m. of October 1 the barometer had fallen to 28.88 inches, while the wind southeast had risen to an estimated velocity of 80 miles an hour—estimated, because at 7:45 a. m. the wind-recording instruments at the Observatory were blown away. At this time squall succeeded squall with rapidly increasing velocity from the southeast, the rain falling in continuous torrents, being driven by the wind with a force that the few adventurous persons who were out found positively blinding. \* \* \* Although much damage was done on land, interest centered on the shipping in the harbour, most of which was in sore straits. \* \* \* At 10 a. m. the barometer reached a minimum of 28.68 inches with wind from the south blowing at an estimated velocity of 60 to 80 miles an hour. At noon the barometer had risen to 29.10 inches.

\* \* \* \* \*

An instance of the value of the storm telegrams is afforded by information obtained from Mr. Wm. Hilton, who arrived this morning from Staniard Creek. He states that a great many of the sponging craft there had been launched and taken out of the creek to the North Side, but that on the receipt by the Rev. Mr. Dinsdale, on Sunday night, of a copy of Saturday's storm telegram, sent by the Port Officer, the vessels were all brought into the creek again and secured. Had this not been done the damage to shipping there would probably have been very great.

The telegrams referred to were sent by the Chief of the Weather Bureau to the Governor of the Bahamas, Nassau. They were begun September 26, 1908, and advised measures to protect shipping.

From the western Bahamas the storm recurved to the east-

ward over the Atlantic. During the 3d and 4th severe gales were experienced on the northeast coast of Cuba, and on the 6th a disturbance that was probably a continuation of the Bahamas hurricane past near Bermuda with a reported barometric pressure of 29.22 inches. After passing Bermuda the storm moved on a north of east course, and on the 6th the meteorological observatories at Horta, Fayal, Azores, and Lloyds, London, were advised regarding its character and probable course over the ocean. A forecast was also made that the storm would pass near and north of the Azores by the night of the 7th and reach the middle-western European coasts by the 9th. During the 7th the barometer fell to 29.66 inches at Horta and then rose rapidly to 30.16 by the morning of the 8th with wind shifting from southwest to northwest. During the succeeding two days the storm apparently moved northeastward and past near and west of the British coasts. On the morning of the 9th it was central northwest of Scotland.

On the 4th, when this storm occupied the subtropical waters of the Atlantic north of the West Indies, a typhoon is reported to have visited the Island of Luzon, P. I.

During this storm period over the Atlantic the weather was unseasonably cool over the interior of the United States, and snow fell in the early part of the first decade of the month in the northern Rocky Mountain districts. The barometric depressions that appeared over the North American Continent possessed slight intensity. It has been observed that in the presence over the western Atlantic of disturbances of tropical or subtropical origin the intensity of storms over the interior of the American Continent decreases as they advance eastward.

During the 8th a shallow barometric depression that had covered Cuban and Florida waters for several days moved northward over the South Atlantic States. On this date also the presence of a typhoon over the Philippine Islands was indicated by the Manila report. From the 8th to 11th the southeastern depression moved slowly over the Atlantic seaboard of the United States, and a disturbance from the British Northwest Territory advanced over the Lake region and St.

Lawrence Valley. Following the unsettled rainy weather that attended these disturbances an area of high barometer and cool, fair weather moved from the British Northwest Territory eastward and southeasterly to the Atlantic and Gulf States, attended by freezing temperature as far south as northwestern Arkansas on the 13th and 14th, and by the first heavy frost of the season in the Middle Atlantic States.

Following this cool period a warm wave carried temperatures 10° to 20° above the seasonal average in middle and northern districts from the Rocky Mountains to the Atlantic coast. The warm wave resulted from abnormally low barometric pressure that existed for several days, beginning October 10, over the northern Pacific Ocean and adjacent parts of the American Continent. This distribution of pressure caused a strong flow of air currents from the warmer latitudes over the interior of the continent. The increasing warmth imparted by these currents to air overlying the region from the Great Plains eastward also contributed to the period of dry weather that began in the middle and northern districts east of the Rocky Mountains about October 11 and continued until about the middle of the third decade of the month.

Note was made in the general forecast of the evening of the 12th that a typhoon was approaching the Island of Luzon, P. I., from the east that would probably strike the Chinese coast near the Island of Hongkong. This storm was very severe over the northern portion of Luzon on the 12th and two days later it struck with destructive force the region about Amoy and Chang-chow, to the northward of Hongkong. This storm was encountered by the American battleship fleet off the north coast of Luzon during October 12 and 13 and there reached its height on the morning of the 13th.

From the 16th to 18th an area of high barometer moved from the interior of British America southward over the Rocky Mountain and Plains States and past thence eastward during the 19th and 20th over the Great Lakes, New York, and New England. From the 14th to 16th a depression crossed the Pacific States attended by the first rain of the season over the northern half of California. From the 18th to 20th a deep barometric depression moved northward along the eastern Rocky Mountain slope and on the morning of the 20th a barometer reading of 28.98 inches was reported at Williston, N. Dak. This depression, in conjunction with the preceding high-barometer area, caused general precipitation from the Mississippi River over the Rocky Mountain and Plateau districts, that in the mountain districts and the Northwest was in the form of snow.

On Tuesday, October 20, the following general forecast was issued:

The barometer has fallen rapidly over the southern Rocky Mountain region, and a well-defined storm will appear in that section Wednesday morning. This storm will move northeastward, attended by rain in the central valleys Thursday, and in the Atlantic States Friday or Saturday. The rains promise to be sufficiently heavy to extinguish the fires in the Allegheny and Adirondack mountains.

The rains set in as forecast, and in the eastern mountain districts, where forest fires were destroying property, they continued several days.

From the 19th to the 23d a period of exceptionally cool weather attended the presence of an area of high barometric pressure over continental Europe. Temperatures in Germany were reported the lowest experienced in October since 1866.

On the 21st and 22d, when the central portion of an area of high barometric pressure occupied the Middle Atlantic States, the kites at Mount Weather penetrated a stratum of relatively warm air half a mile above the station. On the following day the mountain was enveloped in a dense fog, with upper currents strong enough to crush the first kite that was sent up. These strong easterly currents flowed from the southern quadrants of an area of high barometer that was mov-

ing off the north Atlantic coast, thru the north quadrants of a low-pressure area that occupied the south Atlantic coast and toward a low area over Arkansas. This strong drift of air apparently carried the low-pressure area of the south Atlantic coast inland where it united on the 24th with the Arkansas low area that had moved northward to the upper Mississippi Valley. The upper currents in this case indicated at least a day in advance, the abnormal movement of the southeastern disturbance.

From the 28th to 30th a tropical disturbance, that had apparently advanced from the western portion of the Caribbean Sea, past from the eastern portion of the Gulf of Mexico northeastward along the Atlantic coast of the United States, attended by heavy rain and gales. During these dates an area of cool weather and frost advanced from the west Gulf States over the east Gulf and South Atlantic States. It is probable that the storm of the 28-30th was identical with a disturbance that visited the Central American coasts and Yucatan and past thence over the Gulf of Mexico.

October closed with fair weather, except over the extreme northwestern portions of the country, and temperature below the seasonal average from the central valleys over the Atlantic States.

#### BOSTON FORECAST DISTRICT.\*

[New England.]

The month was warmer than usual and, except in localities in Rhode Island and eastern Massachusetts, precipitation was deficient. Light snow fell in all parts of New England, the greatest fall of the month, 1.2 inches, occurring at Bloomfield, Vt. During the second and third weeks of the month the atmosphere was thick with smoke, and in some instances the density of the smoke retarded the movements of vessels. In the northern States there was considerable damage from forest fires. At the close of the month streams and springs were dry and there was great need of general and heavy rains. A storm of unusual severity occurred on the 29-30th. There were no storms without warnings. Frost warnings were issued to cranberry growers on the 3d and 12th and, it is believed, with much benefit to the cranberry interests—*J. W. Smith, District Forecaster.*

#### NEW ORLEANS FORECAST DISTRICT.\*

[Louisiana, Texas, Oklahoma, and Arkansas.]

Precipitation was deficient, except in Oklahoma and the northwestern portion of eastern Texas where exceptionally heavy rains fell during the early portion of the third decade of the month. Cool weather for the season prevailed and frost occurred in the northern portion of the district on eleven dates. The usual frost warnings were issued, and no warnings were issued for dates on which frost did not occur. There were no general storms on the coast and no storm warnings were issued.—*I. M. Cline, District Forecaster.*

#### LOUISVILLE FORECAST DISTRICT.\*

[Kentucky and Tennessee.]

Severe drought prevailed thruout the month, except in a portion of eastern Tennessee. Temperature averaged about normal. Frost was frequent the first and last parts of the month. On the 31st frost was general and heavy in Tennessee and killing in Kentucky. Warnings were issued in advance of the occurrence of all important frosts.—*F. J. Walz, District Forecaster.*

#### CHICAGO FORECAST DISTRICT.\*

[Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas, and Montana.]

The weather thruout the month was uneventful, except as regards the continuation of the drought which broke with the general rains of the 18-25th. No storms that seriously affected navigation on the Lakes occurred.—*H. J. Cox, Professor and District Forecaster.*

## DENVER FORECAST DISTRICT.\*

[Wyoming, Colorado, Utah, New Mexico, and Arizona.]

The feature of the month was the heavy precipitation in western Wyoming, northwestern Colorado, and the eastern counties of Colorado. In the plains region of Colorado the rainfall was excessive on the 18th and 19th. Considerable damage by flood was caused in the southeastern portion of the State by the overflow of the Arkansas River below the mouth of the Picketwire. Warnings of the flood were issued on the morning of the 19th. Temperature averaged lower than usual thruout the district.—*F. H. Brandenburg, District Forecaster.*

## SAN FRANCISCO FORECAST DISTRICT.†

[California and Nevada.]

The month as a whole was one of pleasant weather, with rather less rain than usual. There were no especially noteworthy features.—*A. G. McAdie, Professor and District Forecaster.*

## PORTLAND, OREG., FORECAST DISTRICT.†

[Oregon, Washington, and Idaho.]

Temperature was slightly below the normal, and precipitation, except in a few localities, was in excess of the normal. Frosts in the western sections, altho not more frequent, were heavier than usual. There were three storm periods, but the winds attending them were not severe. The warnings for high winds were timely and beneficial, and warnings were issued for all important frosts.—*E. A. Beals, District Forecaster.*

## RIVERS AND FLOODS.

The drought conditions that persisted during the first three weeks of the months over the middle and northern districts east of the Rocky Mountains held the rivers to their abnormally low stages, and the effects of the rains that fell late in the month were scarcely noticeable. As in September, the effects of the drought were most noticeable in the Ohio River where there was no hope of an early resumption of navigation. At Parkersburg, W. Va., the low-water stage of —0.3 foot was the lowest on record.

There was a moderate flood in the upper Arkansas River,

beginning on the 19th in southeastern Colorado, and reaching Wichita, Kans., on the 23d. At the same time there was a decided rise in the lower Arkansas River and its tributaries, with flood stages in the Neosho River, and in the Arkansas in the vicinity of Fort Smith, Ark. At the end of the month the lower river was still rising, but with no prospect of serious flood. Warnings were issued wherever possible and they were, as usual, valuable and timely.

These floods were caused by heavy rains that extended over eastern Colorado, Kansas, and Oklahoma, beginning on the 18th in Colorado, and reaching a maximum in Oklahoma and eastern Kansas from the 20th to the 22d, inclusive. In the State of Oklahoma, where the rainfall was probably heaviest, the floods were more pronounced and great damage was done; the losses will probably run into millions, but it has thus far been impossible to obtain detailed estimates. Effort will be made, however, to secure data for publication in a later edition of the MONTHLY WEATHER REVIEW.

On the Neosho and lower Arkansas rivers the damage was small, probably amounting to not more than \$25,000.

The heavy rain area extended also into northern Texas, causing a moderate rise in the upper Trinity River; due notice was given and no damage resulted.

Heavy rains in South Carolina on the 22d and 28th were followed by rapid rises in all the rivers of the State; the floods were moderate. Warnings were issued promptly and no damage of consequence resulted.

The highest and lowest water, mean stage, and monthly range at 208 river stations are given in Table IV. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor of Meteorology.*

\* Morning forecasts made at district center; night forecasts made at Washington, D. C.

† Morning and night forecasts made at district center.

## SPECIAL ARTICLES, NOTES, AND EXTRACTS.

## DEFLECTING FORCE DUE TO THE EARTH'S ROTATION.

By R. A. HARRIS. Dated Washington, D. C., September 1, 1908.

In connection with Mr. Okada's recent paper<sup>1</sup> it may be of interest to show how the deflecting force can be obtained by aid of the usual two-dimensional expressions for the acceleration resolved along and perpendicular to the radius vector.

If a material point move in any plane curve, and if  $\rho$  and  $\psi$  denote its polar coordinates, then the acceleration along  $\rho$  increasing will be

$$\text{Acceleration}_\rho = \frac{d^2\rho}{dt^2} - \rho \left( \frac{d\psi}{dt} \right)^2,$$

and that perpendicular to  $\rho$ ,  $\psi$  increasing, will be

$$\text{Acceleration}_\psi = \rho \frac{d^2\psi}{dt^2} + 2 \frac{d\rho}{dt} \frac{d\psi}{dt}.$$

These fundamental expressions are readily obtained either by considering the velocities resolved with reference to polar coordinates at two successive instants of time, or by combining accelerations along the  $x$  and  $y$  directions, the same having been first expressed in polar coordinates.

Next suppose this plane to be tangent to a sphere, the moving point marking, or coinciding with, the point of contact for the short interval considered. Let  $r$ ,  $\theta$ , and  $\varphi$ , denote the polar coordinates of this point ( $\theta$  being north polar distance and  $\varphi$  east longitude from a meridian fixed in space), and let the origin

of its plane coordinates ( $\rho$ ,  $\psi$ ) be taken at the point where the axis of the sphere from which  $\theta$  is reckoned pierces the tangent plane; then

$$\rho = r \tan \theta, \quad d\rho = r d\theta;$$

$$d\psi = \frac{r \sin \theta}{r \tan \theta} d\varphi = \cos \theta d\varphi.$$

Now suppose the velocity along the path to be uniform for the short time considered.

$$\text{Acceleration}_\theta = -r \sin \theta \cos \theta \left( \frac{d\varphi}{dt} \right)^2 = -\frac{\cos \theta}{r \sin \theta} v_\varphi^2$$

$$\text{Acceleration}_\varphi = 2r \cos \theta \frac{d\theta}{dt} \frac{d\varphi}{dt} = 2 \frac{\cos \theta}{r \sin \theta} v_\theta v_\varphi$$

where, of course, the velocities are absolute velocities in space.

On the earth, which rotates from west to east with an angular velocity  $k_1$ , we have

$$v_\theta = v_s$$

$$v_\varphi = r k_1 \sin \theta + v_s$$

where  $v_s$  and  $v_e$  denote velocities relative to the earth's surface.

Hence, acceleration <sub>$\theta$</sub>  of particle moving with reference to the earth's surface — acceleration <sub>$\theta$</sub>  of particle at rest upon the earth's surface =  $-2k_1 v_s \cos \theta$ .

Similarly, Acceleration <sub>$\varphi$</sub>  =  $2k_1 v_s \cos \theta$ .

Hence, the material point is capable of exerting deflecting forces such that

<sup>1</sup> Monthly Weather Review, May, 1908, XXXVI, p. 147.